REMARKS

Claims 14-37 are now pending in the application. Claims 14-19 were previously withdrawn from consideration pursuant to 37 CFR §1.142(b). Claims 20-37 stand rejected under 35 U.S.C. §103(a). Claims 20 and 23 are currently amended to clarify the presently claimed invention. Support for these amendments is found in Applicants' specification as originally filed at Paragraphs 16, 24, and 43. The Examiner is respectfully requested to reconsider and withdraw the rejection(s) in view of the amendments and remarks contained herein.

REJECTION UNDER 35 U.S.C. § 103

Claims 20-37 are presently rejected under 35 U.S.C. § 103(a) over Ayers (U.S. Pat. No. 4,466,869), hereinafter the Ayers reference, in view of Deng et al. *Study of Sputter Deposition of ITO Films for A-Si:H N-I-P Solar Cells*, in Proceedings of 2nd World Conference and Exhibition on Photovoltaic Solar Energy Conversion, pp. 700-703 (1998), hereinafter the Deng reference. This rejection is respectfully traversed.

The present invention relates to corrosion protection of a photoelectrode device. Independent Claims 20 and 23 have been amended to recite this aspect of the present invention, namely that of a corrosion resistant indium tin oxide (ITO) layer coated on a semiconductor in a photoelectrochemical device. Claim 20 recites a semiconductor layer having a first major surface coated with an indium tin oxide (ITO) layer having a thickness of greater than 3000 Angstroms. The thickness of the ITO layer unexpectedly provides a corrosion protection effect. Claim 23 recites a semiconductor layer having a major surface coated with a corrosion resistant indium tin oxide (ITO) layer in the form

of a highly oriented film. Likewise, the highly oriented ITO film unexpectedly provides corrosion resistance. Not all sputtered layers formed of ITO exhibit corrosion resistance in a photoelectrolytic cell, as is detailed by the extensive investigation described in Applicants' specification, at Paragraphs 34-48 and in Figures 2 and 3, for example. As such, the selection of such specific materials that fulfill the requirements of a corrosion-resistant ITO layer is non-obvious.

Neither the Ayers nor the Deng references recognize any issues with corrosion resistance in a photolytic device. The Ayers reference discloses photoelectrodes, which may include semiconductor materials adjacent to a photocatalytic layer that contact electrolyte. The photocatalytic layer may include indium and tin oxides where the semiconductor is an n-type (Col.3 lines 59 and 65). However, there is no specificity as to the thickness or physical morphology of the photocatalytic material. Ayers has no recognition of any potential issues with corrosion, and as such, there is no suggestion or motivation to provide a layer of ITO that is at least 3000 Angstroms thick, which serves to prophylactically minimize or prevent corrosion. Further, the Ayers reference does not suggest or provide any motivation to a skilled artisan to have an ITO layer that is highly oriented for corrosion resistance. The Ayers reference does not teach, suggest, or provide any motivation to protect the photoelectrode from potential corrosion.

The Deng reference investigates sheet resistance and absorption loss of various deposited ITO films, but has no disclosure whatsoever of modifying such a typical ITO film to provide corrosion resistance. In this regard, the Deng reference fails to provide any teaching, suggestion, or motivation to provide a corrosion resistant ITO layer. In fact, the Deng reference teaches away from arriving at the invention as claimed in Claim

20, which requires an ITO layer that is at least 3,000 Angstroms thick. The Deng reference specifically states that the "desirable ITO thickness in an a-Si solar cell is around 65 nm" or 650 Angstrom. (Page 701, first column, first paragraph and second column, first paragraph). In Table 1, the samples as deposited have variable film thicknesses which are then normalized to "an effective sheet resistance (R*)" and "an effective absorption loss (A*))" that correspond to the predicted resistance and absorbance when the material will be used at the optimum thickness of 65 nm (650 Angstrom). (Page 701, first column). Accordingly, in the tests where ITO films were actually applied to solar cells, the films had thicknesses from 65-75 nm or 650-750 Angstrom (see page 702, second column, first paragraph).

Further, corrosion resistant properties are not inherently based on film thickness of an ITO film, because such properties do not always result from a thick film. See for example, in Applicants' specification at Paragraph 43 on page 19, and at Table 2 on page 21, that states that "[b]ased on the assessment of the crystal quality and crystallographic texture using a diffractometer, it was concluded that even though ITO-1 and ITO-8 have comparable thicknesses, the coating on ITO-1 is poorly crystallized", hence ITO-1 has poor corrosion resistance. Further, test results demonstrated that while thick coatings generally had better corrosion resistance than the thin coatings, one of the three thick coatings (*i.e.,* ITO-6 in the Example) had relatively poor corrosion resistance. *See* Applicants' specification at Paragraph 43 on page 19, Table 1 and Figure 2. Hence, corrosion resistance is not solely predicted by the thickness of an ITO layer. Thus, the Deng reference provides no disclosure, motivation or suggestion to

arrive at a corrosion-resistant ITO layer having a thickness of at least 3000 Angstroms as recited in Claim 20.

Likewise, the Deng reference is entirely silent as to any particular morphology of the films. Deng has no disclosure or suggestion to form materials having the highly oriented crystal structure feature of the invention as claimed in Claim 23. The crystallinity and crystal orientation were unexpectedly discovered to have corrosion resistance and were created through specific processing conditions, as outlined in Applicants' specification at Paragraph 43, for example. These specific processing conditions include long deposition times, high temperatures, specific chemical compositions, and specific atmospheric conditions during a sputtering process that contribute to forming a specific crystal structure, *inter alia*. There is no suggestion in either Ayers or Deng to deposit an ITO film for a longer duration to form highly oriented films, particularly where the overall suggestion is to limit the thickness to merely 65 nm, which suggests truncating deposition times rather than extending them. Further, there is no disclosure in either Ayers or Deng to form ITO layers having highly oriented crystals (as recited in Claims 23 and 34) or to form ITO layers having predominantly a cubic-phase oxide and a smaller amount of a hexagonal-phase oxide (as recited in Claims 24 and 33). Specific process limitations affect the physical structure of an ITO layer to impart corrosion resistant properties.

The Examiner indicated that claim limitations in Claims 21, 25-31, and 36 are not given any patentable weight because they are directed to a process. However, the courts have held that such limitations in "hybrid" claims, for example, an apparatus claim that also has process limitations, do indeed have patentable weight when they

bear on the claimed product. For example, in *In re Luck*, 177 USPQ 523,525 (CCPA 1973), the court held that, "it is well established that product claims may include process steps to wholly or partially define the claimed product... To the extent that these process limitations distinguish the product over the prior art, they must be given the same consideration as traditional product characteristics... The method of application could well result in a difference in the coated article..." See also, MPEP 2173.05(o). Thus, Applicants respectfully submit that each limitation in Claims 21, 25-31, and 36 should be given patentable weight. The process limitations recited in Claims 21, 25-31, and 36 each respectively highlight a feature of processing that unexpectedly provides a corrosion resistant ITO coating, and as such, are patentable over the cited art.

Neither the Ayers reference, nor the Deng reference, either independently or combined, provides any disclosure, motivation or suggestion to arrive at the subject matter claimed in independent Claims 20 and 23, or the claims that depend therefrom, namely Claims 21-22 and 24-37, respectively. As such, Applicants respectfully submit that neither the Ayers nor Deng references, either in combination or alone, render Claims 20-37 obvious. Applicants request reconsideration of these claims and allowance thereof.

CONCLUSION

It is believed that all of the stated grounds of rejection have been properly traversed, accommodated, or rendered moot. Applicants therefore respectfully request that the Examiner reconsider and withdraw all presently outstanding rejections. It is believed that a full and complete response has been made to the outstanding Office

Action, and as such, the present application is in condition for allowance. Thus, prompt and favorable consideration of this amendment is respectfully requested. If the Examiner believes that personal communication will expedite prosecution of this application; the Examiner is invited to telephone the undersigned at (248) 641-1600.

Respectfully submitted,

Dated: August 26, 2005

By: Jennifer Woodside Wojtala

HARNESS, DICKEY & PIERCE, P.L.C.
P.O. Box 828
Bloomfield Hills, Michigan 48303
(248) 641-1600

Anna M. Budde
Reg. No. 35,085

Jennifer M. Woodside Wojtala
Reg. No. 50,721

CORRESPONDENCE ADDRESS:
Kathryn A. Marra
General Motors Corporation
Legal Staff - Mail Code 482-C23-B21
PO Box 300 - 300 Renaissance Center
Detroit, Michigan 48265-3000
Ph: 313-665-4708
Fax: 313-665-4976

AMB/JMW/sem